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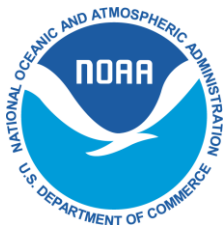
SEFSC Coral Reef Program: FY 2015 Project Accomplishments Report

Compiled by:
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U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service
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March 2017



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*Cover photograph: Juvenile Hogfish, *Lachnolaimus maximus*. Credit: Jaingang Luo*

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LIST OF ACRONYMS

BIRNM	Buck Island Reef National Monument
CCRI	Caribbean Coral Reef Institute
CFMC	Caribbean Fishery Management Council
CIMAS	Cooperative Institute for Marine and Atmospheric Studies at UM/RSMAS
CoRIS	Coral Reef Information System
CRCP	Coral Reef Conservation Program
CREIOS	Coral Reef Ecosystem Integrated Observing System
DNER	Puerto Rico Department of Natural and Environmental Resources
DPNR	US Virgin Islands Department of Planning and Natural Resources
DSG	Digital Spectrogram
EEMP	St. Croix East End Marine Park
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FGBNMS	Flower Garden Banks National Marine Sanctuary
FKNMS	Florida Keys National Marine Sanctuary
FL	Florida
FWC	Florida Fish and Wildlife Conservation Commission
FY	Fiscal Year
LPI	Line Point Intercept
MPA	Marine Protected Area
NCCOS	NOS National Centers for Coastal Ocean Science
NCEI	National Centers for Environmental Information
NCRMP	National Coral Reef Monitoring Program
NE	Northeast
NMFS	NOAA's National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	NOAA's National Ocean Service
NPS	National Park Service
OECA	Oculina Experimental Closed Area
PARR	Public Access to Research Results
PI	Principal Investigator
PIFSC	NMFS Pacific Islands Fisheries Science Center
PR	Puerto Rico
QA/QC	Quality Assurance/Quality Control
ROV	Remotely Operated Vehicle
RSMAS	University of Miami's Rosenstiel School of Marine and Atmospheric Science
RVC	Reef Visual Census
SAFMC	South Atlantic Fishery Management Council
SEAMAP-C	Southeast Area Monitoring and Assessment Program – US Caribbean
SEFCRI	Southeast Florida Coral Reef Initiative
SEFSC	Southeast Fisheries Science Center
SERO	NMFS Southeast Regional Office
UM	University of Miami
UPR/UPR-M	University of Puerto Rico/University of Puerto Rico - Mayaguez
US	United States
USVI	United States Virgin Islands
UVI	University of the Virgin Islands

I. INTRODUCTION

The NOAA Coral Reef Conservation Program (CRCP) is a matrix program operating across four NOAA line offices: National Ocean Service (NOS), National Marine Fisheries Service (NMFS), National Environmental Satellite, Data, and Information Service (NESDIS), and Oceanic and Atmospheric Research (OAR) and is administered by NOS. The program works with other federal agencies, states, territories and commonwealths, and local governments to conserve, protect and restore coral reefs across the United States (US) and internationally. The program has been operating under the strategic guidance of the CRCP's 2010-2015 ["goals and objectives"](#) to address three main threats: fishing impacts, land-based sources of pollution, and climate change.

The Southeast Fisheries Science Center (SEFSC) has been a leader in coral reef conservation science since 1978. Congress passed the Coral Reef Conservation Act in 2000 and the SEFSC dovetailed its management-relevant coral reef science with the newly formed CRCP program. SEFSC maintains a strong coral reef science program and continues to deliver high-caliber, peer-reviewed science in support of coral reef conservation and management and other mandates to conserve the nation's fisheries, protect essential fish habitat, and recover protected species. Recent activities that have shaped the course of SEFSC's coral reef science program include the reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (2006), which drew attention to data deficiencies for coral reef fisheries; the listing of 7 Atlantic corals (2 in 2006, 5 in 2014) as threatened under the Endangered Species Act (ESA); and the advent of the CRCP's National Coral Reef Monitoring Program (NCRMP) in 2013. NMFS plays a critical regulatory role to effect change on coral reefs, and in 2015 NMFS took a more coordinated approach to organizing its coral reef ecosystem research and management both within and external to CRCP.

In Fiscal Year (FY) 2015, CRCP supported 11 SEFSC-led projects totaling about \$1.48M. While most projects continued to address fishing impacts or the status and recovery of protected coral species, SEFSC also investigated recreational fishing effort in the US Caribbean, and the recovery of spawning aggregations in Florida (FL) and the US Caribbean. SEFSC also maintained a leadership role in NCRMP. New activities included a project to determine coral larval competency to assist with coral population modeling, and a new facet of ongoing parrotfish research focused on the US Virgin Islands (USVI) that investigates the interplay among parrotfish populations, their dietary preferences and feeding behaviors, and how this impacts habitat for coral larval settlement. In addition, the SEFSC continued to work with the South Atlantic Fishery Management Council (SAFMC) to monitor effectiveness of Marine Protected Areas (MPAs) in the southeast US Atlantic region.

In 2015, a bleaching event occurred in the Atlantic/Caribbean for a second year in a row. Some corals that survived the 2014 event, succumbed to bleaching in 2015. The 2015 event was part of a global coral bleaching event that impacted corals worldwide and received international media attention. SEFSC's coral experts invested additional time in the water over the last two years to fully document how the corals responded to these back-to-back assaults. For example, those that survived may be compromised in other ways such as being more vulnerable to disease or experiencing impaired reproduction. With no reprieve from myriad threats in sight, coral experts, including those at SEFSC, are ratcheting up their efforts to stem the loss of coral and are embracing more interventionist strategies for recovery and restoration. The long-awaited recovery plan for the *Acropora* corals was finally published in 2015, giving coral scientists and managers a road map for actions to recover these threatened species and a head-start for drafting the recovery plans for the additional listed coral species. Coral recovery will continue to be an important topic for SEFSC in the coming years.

In 2015 we said farewell to John Christensen, CRCP's program manager. He left CRCP to lead his compatriots at the NOS Biogeography Branch. Jennifer Koss, of the NMFS Habitat Office and a longtime CRCP veteran was named acting program director. We also bid adieu to Jessica Morgan, the CRCP NCRMP coordinator, and welcomed her replacement, Justine Kimball.

This annual accomplishments report provides information on the activities and accomplishments of SEFSC projects funded by the CRCP in FY15. SEFSC gratefully acknowledges funding support from NOAA's CRCP.

II. PROGRAM COORDINATION

Project ID#:	1250-2015
Title:	SEFSC Coral Reef Conservation Program Coordination and Communication
PIs and co-PIs:	Jennifer Schull (SEFSC)
Duration of Project:	Year 2 of 3
Project Category:	Program Coordination

Brief description of activities conducted in FY2015

This project provided program management and coordination for SEFSC's portfolio of coral reef related activities in FY15. It covered coordination of SEFSC projects, budgets, accomplishments reporting, proposal development, and science communication. It ensured SEFSC participation in all CRCP related strategic planning initiatives, teams, and working groups, and ensured all SEFSC activities were integrated with and communicated to the relevant management entities. This project supported SEFSC representation in NCRMP development and execution.

Description of accomplishments & results

In FY15, the Program Manager continued coordination and communication of SEFSC's coral reef science program. Coral activities and issues were a focus of the January 2015 NMFS Leadership Council meeting, which required intense coordination with both the Southeast Regional Office (SERO) and the Pacific Islands Fishery Science Center (PIFSC) to ensure consistent messaging. NMFS implemented regional coordination for the CRCP FY16 request for proposals and the Program Manager was responsible for leading that effort on behalf of SEFSC and coordinating with both SERO and the Restoration Center. The Program Manager helped coordinate SEFSC's Protected Resources Science Review, and liaised with the CRCP on the early phases of planning for the CRCP's 2016 Science Evaluation.

The Program Manager led the priority setting exercise for NOAA's Deep Sea Coral Research and Technology Program's return to the southeast region in 2016 and was a co-lead for the MARFIN workshop to evaluate fishery independent data sources for stock assessment in the US Caribbean. The outcomes of that workshop will have consequences for improving the stock assessment process for reef-related fisheries.

For NCRMP, the Program Manager continued to represent SEFSC to the NCRMP program, ensuring the field missions were successfully completed, supporting the development of the pilot coral reef report card for Florida, and ensuring successful planning and execution for 2015 monitoring activities in USVI and Flower Garden Banks National Marine Sanctuary (FGBNMS).

The Program Manager took an active role in administrating SEFSC's parrotfish project and ensured the USVI Creel Survey project was redesigned and implemented by SEFSC's Social Science Research Group. The Program Manager managed all CRCP budgeting and assisted in contracting – including the purchasing of a new vessel hull to support SEFSC's SCUBA-dependent missions. The Program Manager coordinated SEFSC submissions to the Coral Reef Information System (CoRIS) and Public Access to Research Results (PARR) data archiving and metadata initiatives. The Program Manager delivered required data for the US Caribbean reef fish biological opinion and worked with SERO to draft a new

biological opinion that will better reflect the science behind the relationships among parrotfish, herbivory and ESA coral critical habitat.

The Program Manager hosted visitors to SEFSC and represented the SEFSC's coral reef work by ensuring coral reef science was included in briefing materials and presentations. For example, Jennifer Koss, CRCP Program manager, and Marie Bundy, acting CRCP deputy, attended the SEFSC's ESA program review in Miami and participated in a field trip to observe Margaret Miller's ESA coral spawning work. Other visitors to the SEFSC included Vice Admiral Devaney, Dr. Richard Spinrad, Eileen Sobeck, Dr. Kathryn Sullivan, Dr. Luis Solorzano (The Nature Conservancy), Dr. Tauna Rankin and several Congressional staffers at SEFSC.

The Program Manager facilitated CRCP communications by participating in the communications working group and contributing science stories such as Ron Hill's fish trap efficacy project, Roldan Munoz's humphead parrotfish work, and Margaret Miller's work on the impacts of coral bleaching for the CRCP website. The Program Manager coordinated two Coral Collaboration seminars by SEFSC coral reef scientists. This year, an intern was hired to assist with a synoptic coral reef report for 2011-2014, which is still in progress. The 2014 CRCP Accomplishments report was completed.

How project supports goals & objectives of CRCP

This project ensures that the SEFSC is fully engaged in CRCP programs and generates projects and outputs aligned with the goals and objectives of the CRCP. This project ensures SEFSC's projects meet the needs of the coral reef management community, and provides leadership support for SEFSC's role in NCRMP. It ensures that SEFSC PIs are responsive to CRCP needs and that SEFSC speaks with one voice. This project ensures that SEFSC's coral-related activities are communicated to a wide variety of audiences.

How project supports management of coral reef resources

This project guides development of coral projects that will have meaningful impacts on the conservation and management of coral reefs. It synthesizes the expert advice and scientific outputs of SEFSC coral reef related projects for incorporation into scientifically sound management actions. It integrates CRCP outputs with those from other NMFS activities related to habitat, sustainable fisheries, and protected species. It also integrates SEFSC's coral reef activities with other NOAA and NMFS activities nationally and internationally such as NOAA in the Caribbean and the NOAA Caribbean Strategy.

List of project partners and their roles

None

Communications, media exposure, capacity building, education and outreach activities

The FY14 Accomplishment Report was published as a Technical Memorandum (see below). The Program Manager hosted quarterly check-in calls with SEFSC coral scientists, attended coral collaboration conference calls, and organized SEFSC participation in CRCP science stories and coral collaboration seminars. The Program Manager ensured SEFSC science was included in NOS Coral Week and that SEFSC was included in all communications regarding the Port of Miami coral rescue. The Program Manager participated on selection committee for the selection of a 2016 Caribbean Sea Grant Caribbean Fellow, and kept in close contact with local and regional partners related to Reef Visual Census (RVC) and NCRMP monitoring.

Submissions to CoRIS

See below

FY2015 Publications

SEFSC Coral Reef Program: FY 2014 Project Accomplishments Report. Compiled by Jennifer Schull. NOAA Technical Memorandum. NMFS-SEFSC-683, 38p.

Shideler, G.S., SR Sagarese, WJ Harford, J Schull, JE Serafy. 2015. Assessing the suitability of mangrove habitats for juvenile Atlantic goliath grouper. Environ. Biol. Fish. 98:2067-2084. DOI: 10.1007/s 10641-015-0430-4.

FY2015 Presentations

Informal presentations to NMFS leadership on spend plan process, priorities and accomplishments

Setbacks or challenges encountered in FY2015

None

Comments on future direction of project

This project is expected to continue providing valuable oversight and coordination of SEFSC's coral reef related activities.

III. REDUCE ADVERSE IMPACTS OF FISHING

Project ID#:	453-2015
Title:	Assess/Monitor Effects of Marine Protected Area (MPA) Status on Fish Populations and Spawning Aggregations in the Tortugas Ecological Reserves
PIs and co-PIs:	Michael Burton (SEFSC) & Roldan Munoz (SEFSC)
Duration of Project:	Year 3 of 3
Project Category:	Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2015

From July 2-7, 2015, the SEFSC team conducted a research cruise to monitor reef fish populations in the Tortugas Ecological Reserve (TER). During this cruise, the team completed 180 individual dives in the 53'-130' depth range of both the south and north reserves over five days without incident. The team completed conventional reef fish monitoring dives and lionfish monitoring dives (20 in the south reserve, 9 in the north reserve). The team monitored reef fish populations by replicating randomly oriented 30m line transects on which all snapper, grouper, and other predators were identified and enumerated. The team also conducted a limited number of fish surveys using two additional methodologies: the reef visual census stationary point count (n=31), and the Reef Environmental Education Foundation roving diver survey (n=10). The team was limited in the amount of surveys they could complete using these other two methodologies due to fewer personnel trained in the methods.

As part of this work, the team also investigated the effects of invasive lionfish on the native reef fish communities, and the possibility of predators (snappers/groupers) to control lionfish populations. Lionfish effects were studied by conducting targeted lionfish predator and prey surveys using 50m line transects during which divers counted conspicuous species on the way out, and identified the cryptic species components on the return. On lionfish protocol dives, one diver was tasked with doing a qualitative habitat assessment.

The team also sought to confirm a recently discovered cubera snapper aggregation on the western edge of Riley's Hump.

Description of accomplishments & results

Results of diver observations indicated elevated levels of mutton snapper, including occurrences of 60 fish on one dive, over 500 fish upon ascending from one station, and over 1000 mutton snapper upon arrival at the bottom on one dive. Divers reported many fish looking "full" or gravid, a possible indication they were in spawning condition. Scientists made six dives in areas where three or more black groupers were seen on the same station, and during nine of the dives, the team observed a black grouper that measured 100 cm in length or greater. The number of sharks seen seemed to be increasing, with sightings of several species, including lemon (220 cm), bull (213 cm), reef (150 and 200 cm), nurse (182 cm), and unidentified sharks.

Additionally, the team investigated a recently discovered (2012) cubera snapper aggregation that forms on the western edge of Riley's Hump, in depths up to 200'. Scientists were able to dive to a depth of 130' and observe fish below, as visibility was exceptionally good. Multiple aggregations were found at the same site. The team observed cubera snapper aggregations on the same site over repeated days. The

aggregations consisted of several hundred individuals and exhibited spawning coloration as documented in literature. These dives (n=18) were made beginning in early afternoon and continued until close to dusk, as previous studies that have observed lutjanids aggregate indicate spawning takes place later in the day.

How project supports goals & objectives of CRCP

This project supports CRCP National Objective F2.5 – monitoring to assess the effectiveness of MPAs; Objective F2.4 - Work with relevant agencies, offices, and communities to improve the management of MPAs; Objective F1.3 - Obtain essential life history and ecological information on key species or functional groups to support management actions; and Objective F1.6 - Conduct applied research and monitoring to evaluate effectiveness of coral reef ecosystem management actions on key species or groups. The project supports the following FL objectives and priorities: FL Objective D1.1 - Fill monitoring and assessment gaps, including fisheries dependent and independent monitoring, to further understand the effects on other trophic levels; FL Objective D1.2 - Identify larval sources, spawning areas, and aggregations; FL Coral Reef Priority A1.2 - Develop and implement a comprehensive zoning plan for the entire FL Reef Tract and Ecosystem and implement through place-based entities and management plans within three to five years (potential expansion of MPAs is part of zoning plan consideration currently ongoing in the FL Keys); and FL Coral Reef Priority Goal A3 - Improve understanding of status and linkages of human activities to the condition and trends of the FL Reef Tract and Ecosystem, Objective 1 - Create a full inventory of status, trends and threats to coral reef resources across the entire FL Reef Tract and Ecosystem within five years. This project aids managers in understanding the benefits of properly managed coral reef marine reserves, from both a habitat and fishery standpoint.

How project supports management of coral reef resources

Information gained from this project will assist the Florida Keys National Marine Sanctuary (FKNMS) and the Florida Fish and Wildlife Conservation Commission (FWC) in assessing the effectiveness of properly managed MPAs in recovering exploited fish stocks and maintaining proper ecosystem health and function on the reef. Since 2002, this project has documented the reformation of an overfished spawning aggregation of mutton snapper, and have noted other snapper/grouper species increasing in numbers in the years since reserve creation in 2001. Data from this project were used in a NOAA/FWC mutton snapper stock assessment in 2007, and have been provided for use in a stock assessment now ongoing for the SAFMC and FWC.

List of project Partners and their roles

- NCCOS - Center for Coastal Fisheries Habitat Research – In-kind donation of time for cruise participation; split beam sonar mapping of habitat.
- FKNMS – In-kind donation of Scott Donahue salary, research coordination.
- FWC Marathon Laboratory – In-kind donation of divers for cruise participation.
- UM/RSMAS – In-kind donation of time for divers for cruise participation.

Communications, media exposure, capacity building, education and outreach activities

The FKNMS served as a team member in this project not only because the research takes place in their jurisdiction, but also because the results are directly relevant to management of their resources. The FKNMS was kept informed of the progress of the research efforts. At the conclusion of this project, the analyses and conclusions will be disseminated to them in the form of technical reports, a final report, and a presentation to the members of the sanctuary advisory board.

Additionally, results will be disseminated to partners at FWC and the regional fishery management councils. The data have been provided to FWC for use in the Southeast Data, Assessment and Review (SEDAR) stock assessment process.

Submissions to CoRIS

None

FY2015 Publications

None

FY2015 Presentations

Progress on the cubera snapper aggregation exploration was highlighted by Nick Farmer (SERO) in a brown bag presentation to SERO in St. Petersburg in the fall of 2015.

Setbacks or challenges encountered in FY2015

There were no issues with the project as originally planned. However, the team was unsuccessful in obtaining additional funding so that additional decompression diving could be conducted to examine the cubera snapper aggregation. Spending extra time at depth (200 ft.), would have allowed the team to better characterize this aggregation.

Comments on future direction of project

Field operations for this project are complete and data analysis and reporting are ongoing. The team is still interested in working with the management partners to explore the function of MPAs such as Riley's Hump (Tortugas Ecological Reserve-South) in recovering overexploited stocks of reef fishes such as mutton snapper, as well as protecting other high profile species (e.g., black grouper). The team would also like to continue observation and monitoring of the function of the deep-water cubera aggregation site on the western edge of Riley's Hump.

Project ID#:	1064 – 2015
Title:	National Coral Reef Monitoring Program
PIs and co-PIs:	PI: Jim Bohnsack (SEFSC); CoPI: Jerry Ault (UM/RSMAS), CoPI: Steven Smith (UM/RSMAS)
Duration of Project:	Year 1 of 1, ongoing project
Project Category:	National Coral Reef Monitoring Program

Brief description of activities conducted in FY2015

The NCRMP Atlantic Biological Monitoring team conducted field missions in the USVI (St. Croix – June 2015; St. John/St. Thomas – July 2015) and FGBNMS (August 2015). Prior to conducting the field work, the team provided in-water and classroom training for 68 field staff from NOAA and partner agencies/universities at 6 locations. In total, 55 individual divers participated in the monitoring effort. The field missions included reef fish surveys, via line transects; and benthic surveys, via line-point intercept (LPI) benthic cover surveys, and line transect coral demographic surveys. NCRMP PIs also worked with the PIFSC, SERO, and the socioeconomic and climate components of NCRMP to collaborate and maintain open channels of communication.

The NCRMP team invested considerable effort in finalizing the data from the 2014 field season (FL and Puerto Rico (PR). All data were entered into the data entry portal, error checked, Quality Assurance/Quality Control (QA/QC) checked, and integrated into a new database. This process is well underway for the 2015 data. Data managers initiated a QA/QC test to allow field participants to conduct a self-review of data entry prior to internal procedures and the test found self-review inadequate. The NCRMP team will work together to refine and streamline QA/QC procedures. The NCRMP team is working with both CoRIS and individual line office requirements for PARR - which aims to make all federally funded data accessible, understandable and safely archived. The data analysis teams implemented analytical scripts (written in the R programming language) to develop graphics and tables for data summaries (targeting 2013 data). Ongoing activities include continuing work on optimizing sample allocation, improving regional map resolution, and reporting.

The NCRMP team continued working with partner agencies to ensure NCRMP remains a highly leveraged, collaborative effort. PIs worked with the FL partners to plan for the assimilation of the Southeast Florida Coral Reef Initiative (SEFCRI) region into the NCRMP framework in 2016, once the separate SEFCRI baseline monitoring assessment is complete.

NCRMP was well represented as NMFS embarked on a coral reef priority setting initiative. NCRMP principals worked with SERO and PIFSC on briefing materials for Eileen Sobeck, NMFS Assistant Administrator, and for a NMFS Leadership Council presentation in January 2015.

Description of accomplishments & results

In St. Croix, 239 fish/LPI and 139 coral demographic surveys were conducted. In St. Thomas and St. John, 255 fish/LPI and 168 coral demographic surveys were completed. In the FGBNMS, 63 fish/LPI and 30 coral demographic surveys were conducted. In total, 894 surveys were completed across USVI and FGBNMS. The field teams also collected 120 water samples for the NCRMP climate team. No safety violations or accidents were observed. All 2014 and 2015 were data entered and QA/QC'd and 2014

NCRMP accomplishments were entered into CRCP database. SEFSC also purchased a new small boat which will primarily be used for NCRMP activities.

How project supports goals & objectives of CRCP

Monitoring of coral reef fish and habitat resources is critical to the assessment of ecosystem status and the effectiveness of management actions, particularly as they relate to MPAs (objective F2.5) and the effects of other fishery management actions (objective F1.6) on coral reef ecosystems.

How project supports management of coral reef resources

NCRMP provides baseline data on reef fish and reef benthic communities to help describe how reefs are changing over time. Data and analytical results are shared with the State of Florida, territorial managers (USVI and PR), the NPS, and NOAA Sanctuary managers to support and guide management decisions within US Atlantic coral reef ecosystems.

List of project partners and their roles

- Texas A&M University – Field work support
- UVI – Field work support
- UM – Survey design, data analysis and field work support
- NPS – Field work support, data analysis
- EPA Gulf Ecology Division – field work support.
- USVI DPNR – field work support.

Communications, media exposure, capacity building, education and outreach activities

Data and tools were made available to NMFS Protected Resources (recovery planning and Protected Resources Toolbox Project) and to EPA in support of biological condition gradients. Trainings and field missions provided opportunities for ad-hoc interaction with partners, resource managers and field teams.

<http://stjohnsource.com/content/news/local-news/2015/07/19/coral-monitoring-study-gives-inkling-good-news>

Submissions to CoRIS

See below:

FY2015 Publications

2015 Protocol documents: <http://coastalscience.noaa.gov/projects/detail?key=180>

2013 Data Summary:

<http://www2.coastalscience.noaa.gov/publications/detail.aspx?resource=0cycUZfsEvttLtzQ9gkC8Z85mNJ9aekeI5YdJMeU1fw=>

FY2015 Presentations

Coral Reef Task Force - October 2015

NCRMP Florida Report Card Pilot - November 2015

Setbacks or challenges encountered in FY2015

The workload for data archiving, analysis and reporting are outstripping capacity. Over the next couple of years the NCRMP team plans to investigate rebalancing the distribution of labor and investing more in automating data QA/QC and analysis scripts. Surveying PR and FL in the same year continues to be a concern as they are the two largest, most logistically difficult, and resource intensive regions to survey.

Comments on future direction of project

NCRMP will conduct field work in PR and FL in 2016.

Project ID#:	0831-2015
Title:	A Creel Survey of the Recreational (Non-Commercial), Boat-Ramp-Based Fisheries in St. Croix
PIs and co-PIs:	Brent Stoffle (SEFSC), Scott Crosson (SEFSC) & Matthew McPherson (SEFSC) (formerly Jim Berkson (SEFSC))
Duration of Project:	Year 3 of 3
Project Category:	Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2015

This project will collect catch and effort data from the non-commercial, boat-ramp based fisheries in the US Virgin Islands to better understand this fraction of the fishing community in the US Caribbean and to provide improved management advice. The project will include a survey component targeting the fishers, and will also include a creel component which will quantify the fish caught. This project will advance NOAA's understanding of non-commercial fishery components in the US Caribbean and will assist the evolving Marine Recreational Information Program (MRIP) as it develops in the Southeast US and US Caribbean.

This project was funded by CRCP from 2013 – 2015. However, there have been extensive delays related to working with academic partners, and a change in project leadership. The project is now on track and has a firm work plan that will be executed in 2016 with no additional costs to the CRCP.

Description of accomplishments & results

The SEFSC's Social Science Research Group has taken over project management, data collection, analysis, and deliverables. The team completed all the necessary Paperwork Reduction Act requirements for the Office of Management and Budget. Project funds are now at CIMAS and fieldwork will begin in 2016.

How project supports goals & objectives of CRCP

This project specifically addresses objective 1.4 to "Obtain necessary information on fishing effort in U.S. coral reef ecosystems by measuring fishing intensity, fishing mortality, frequency, area coverage, community dependence, etc. to inform management activities." This project addresses one of the most difficult facets of fishing effort to quantify – recreational and artisanal effort and catch in the US Caribbean. The non-commercial, boat-ramp-based fisheries in St. Croix are assumed to be significant fisheries on the island, but data are not currently available. This project will begin to provide this missing component of fisheries effort. Results of this project should also assist in the "creation or improvement of coral reef fisheries management plans that address ecological, social, and economic considerations (F1.1).

How project supports management of coral reef resources

The project will answer two important research questions: (1) What is the best way to collect essential data for these fisheries, and (2) What are the current levels of catch and effort in these fisheries? At the termination of the project, information will be provided to relevant territorial and federal fisheries managers to prevent overexploitation of stocks, bycatch, and gear impacts.

List of project partners and their roles

- NMFS/SEFSC Sustainable Fisheries Division - Review of data collection protocol, storage methods, and analytical tools.
- NMFS/SEFSC Social Science Research Group - Review the socio-economic aspects of the study to ensure best practices.
- UM/RSMAS-CIMAS - Help design, implement, manage, analyze and write-up the study.
- The Caribbean Fisheries Management Council (CFMC) - Ensure that the project is filling a critical data gap need to better manage fisheries in the USVI.
- The USVI DPNR Division of Coastal Zone Management - Provide information about the spatial distribution of reef habitat that can be compared with the distribution of fishing effort estimated by the creel survey.
- The USVI DPNR Division of Fish and Wildlife - Provide feedback on project design and execution to ensure that the project meets its needs. It will also provide expertise on the fish, fishers, and fisheries of St. Croix.

Communications, media exposure, capacity building, education and outreach activities

None

Submissions to CoRIS

None

FY2015 Publications

None

FY2015 Presentations

None

Setbacks or challenges encountered in FY2015

After a number of setbacks the project is now on track to complete planned fieldwork in 2016.

Comments on future direction of project

Field work should begin in June/July 2016

Project ID#:	1100-2015
Title:	Assessing Performance and Connectivity of St. Croix MPAs
PIs and co-PIs:	Jennifer Doerr (SEFSC) & Ron Hill (SEFSC)
Duration of Project:	Year 2 of 3
Project Category:	Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2015

FY2015 research activities were conducted during field expeditions to St. Croix, USVI in April and August 2015. Working with staff from the NPS, the team tagged juvenile and adult queen conch inside Buck Island Reef National Monument (BIRNM). The team conducted radial surveys and described the benthic composition at each tagging site. The latest set of acoustic data was downloaded from the hydrophone array in November 2015, and these data are currently being added to the existing database for analysis.

Description of accomplishments & results

During this year's field work, the team tagged 23 queen conch (14 juveniles and 9 adults) with numbered identification and acoustic transmitters at 11 sites along a depth (from 6 – 20 m) and habitat gradient within BIRNM. Tagging operations were conducted at the beginning and near the peak of the reproductive season when adult conch are known to migrate to spawning sites. At each tagging site, a 10m radial survey was completed, and a total of 533 conch (429 juveniles and 104 adults) were located and measured in sand, seagrass, and colonized pavement/hard bottom habitats. Densities of conch calculated from radial survey data were twice as high as FY14 survey results, with a mean density of 1542.4 conch per hectare. This was mainly due to increasing numbers of young juveniles utilizing seagrass areas as nursery habitat, particularly during the August surveys.

Continued updates and analysis of tracking information confirm that adult conch are exhibiting higher rates of movement than juveniles. Several adult conch have now been tracked moving south and east from BIRNM toward the mainland of St. Croix, crossing out of the reserve into open fishing areas, and subsequently disappearing from the array.

How project supports goals & objectives of CRCP

The queen conch is important culturally and is an extremely valuable coral reef fishery resource throughout the Caribbean, historically second in value only to the spiny lobster. Habitat degradation and overfishing have led to significant declines in population numbers from historic levels. Populations of queen conch have been slow to recover in spite of management measures including complete fishery closures, shortened harvest seasons, and size restrictions. MPAs can increase the abundance of exploited marine species, but the effectiveness of a reserve area for a slow-moving benthic species like queen conch depends heavily on matching area, configuration, and location of MPA boundaries to the ecological needs of the species. This project supports the objectives of the CRCP, especially F2.5, by assessing the performance of the BIRNM marine reserve and the connectivity within the local network of reserve areas, while providing the basis to protect and restore queen conch populations near St. Croix.

How project supports management of coral reef resources:

Queen conch were once abundant in coral reef ecosystems, but declines in population numbers are consistently reported throughout their range. Within the US Caribbean, queen conch are currently managed with daily catch quotas, annual total catch limits, seasonal closures coinciding with the main reproductive period (June 1 – October 31), and spatial closures or marine reserves. Reserves are managed by both local jurisdictions (e.g., East End Marine Park (EEMP) and federal agencies (e.g., BIRNM), and vary in their fishing regulations from full closures to managed areas. To maximize management effectiveness, both seasonal and spatial closures need to match characteristics of the species' life history patterns. This project is documenting spatial distributions, habitat use, and migration patterns of juvenile and adult queen conch in relation to existing MPA boundaries and identifying critical spawning areas. Data obtained from the acoustic tracking component will provide information on resource connectivity by determining if and when conch move between management zones, most importantly into the open fishing areas between no-take zones, and the timing and duration of these movement patterns. If this project discovers that there is some aspect of conch movement around BIRNM making them more vulnerable to capture during critical times, recommendations for management modifications will be drafted and submitted to the appropriate managers.

List of project partners and their roles:

- NPS – The St. Croix NPS office is overseeing and coordinating activities with all collaborators on the larger acoustic tagging and tracking project. Agency personnel are contributing input on the experimental design, installing hydrophone receivers, downloading and maintaining receivers, disseminating data to research groups, and providing vessel and personnel support during field trips.
- NOS/NCCOS/Biogeography Branch – Contributed acoustic receivers to the project and are tagging reef fish in the study area.
- US Geological Survey –Contributed acoustic receivers to the project and is tagging sea turtles in the study area.
- Massachusetts Division of Fish and Wildlife –Contributed acoustic receivers to the project and is tagging sharks in the study area.
- University of Massachusetts – This partner has contributed acoustic receivers to the project and is tagging reef fish. They will also be providing analytical support as needed.
- UM –Contributed acoustic receivers to the project and is tagging reef fish.
- UVI –Contributed acoustic receivers to the project and is tagging reef fish. They will also assist with configuration and deployment of nearshore hydrophones in the EEMP.

Communications, media exposure, capacity building, education and outreach activities

The PI performed public outreach activities at the NOAA Fisheries Galveston Lab open house in April 2015, attended a CFMC meeting in April 2015, and presented a seminar at the Galveston Lab in August 2015.

Submissions to CoRIS

None

FY2015 Publications

None

FY2015 Presentations

Doerr, J. C. and R. L. Hill. Assessing queen conch home range, habitat use, and movement in the U.S. Virgin Islands. CFMC meeting, St. Croix, VI. April 2015.

Setbacks or challenges encountered in FY2015

None

Comments on future direction of project

Tagging and radial surveys of queen conch will continue in the study area through FY2016, the final year of confirmed funding. Field sampling will continue to include range testing to further define detection zones of acoustic hydrophones throughout the array, supplementing detection information collected by the project's US Geological Survey and UM partners. The team will also attempt to relocate previously tagged conch via manually operated directional receivers to confirm their locations within the array. Joint efforts with the NPS and other project partners will continue in the planning and placement of additional receivers.



Divers measuring the shell length of queen conch located during a radial survey (photo credit: Jennifer Doerr).

Project ID#:	30061-2015
Title:	Impacts of Fishing on Parrotfish Grazing in St. Croix –A Case Study on the Ecological Impacts of Fishery Management Actions
PIs and co-PIs:	PI: Margaret W. Miller (SEFSC), CoPI: Benjamin Ruttenberg (California Polytechnic), CoPI: Tom Adam (University of California Santa Barbara)
Duration of Project:	Year 1 of 3
Project Category:	Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2015

During FY2015, a field mission to St. Croix, USVI was planned and executed to collect data for developing species-specific grazing metrics of common parrotfish and exploring spatial and temporal patterns of parrotfish grazing. The researchers used focal behavioral observations and surveys to document grazing preferences, grazing rates, and habitat selection by six common species of parrotfish at multiple sites on the north shore of St. Croix, including BIRNM. In addition, patterns of corallivory by parrotfish were documented by quantifying bite scar density on corals, and video data to document species-specific predation rates on corals was collected.

Description of accomplishments & results

The research team successfully completed the field work and is currently processing photographic and video data. Analysis of parrotfish grazing patterns and habitat selection revealed very similar patterns to those observed in the Florida Keys through a related CRCP project (Adam et al. 2015a). *Sparisoma viride* and parrotfishes in the genus *Scarus* were observed preferentially feeding on closely cropped algal turfs. In contrast, other *Sparisoma* spp. preferentially fed on brown macroalgae and/or on longer algal turf assemblages. Also similar to the Florida Keys study, project scientists found evidence for fine-scale habitat partitioning among species with similar diets, suggesting that each individual species of parrotfish plays a unique ecological role in the coral reef ecosystem. These results have been presented at a poster session at a regional ecological meeting in California and at an undergraduate symposium at the UVI (see FY2015 presentations).

Data from focal behavioral observations and corallivory videos suggest that the primary corallivore on the reefs of St. Croix is *Sparisoma viride*. Surveys of parrotfish bite scars revealed a high level of variability in the incidence and intensity of corallivory on different species of corals among sites and habitats. This project's data suggest that this variability may be related to variation in the density of *S. viride* and their preferred coral prey.

How project supports goals & objectives of CRCP

Parrotfishes are both important fishery species as well as key grazers that can facilitate growth and survivorship of reef-building corals. The largest parrotfish fishery in the U.S Caribbean is in St. Croix and there is a need to understand how the fishery impacts coral reef ecosystems around St. Croix. This research directly supports CRCP Fishing Impacts Objective F1.3 to “obtain essential life history and ecological information on key species or functional groups to support management actions”. This research also supports Fishing Impacts Goal 2 by synthesizing research on the effectiveness of MPAs at protecting key coral reef ecosystem components and functions.

How project supports management of coral reef resources

This project describes how grazing pressure by parrotfishes varies in space and time around St. Croix and how this relates to current and historical management actions. These data will be used to forecast the effectiveness of different management strategies (e.g., gear restrictions, size and bag limits, spatial management, etc.) for conserving the key ecological functions provided by parrotfish (e.g., the removal of macroalgae that can negatively impact corals and the provisioning of space for coral recruitment). The outcome of this work can be used directly to help develop fisheries management strategies to reduce potential conflicts between parrotfish fisheries and the need to maintain high levels of grazing in habitats suitable for major framework building corals, including ESA-listed species.

List of project partners and their roles

- University of California, Santa Barbara (Dr. Adam & Dr. Burkepile) - Leads and carries out all components of the project, including field work, synthesis, and reporting..
- California Polytechnic State University, San Luis Obispo (Dr. Ruttenberg, M. Roycroft), - Plans for and carries out field work and aids in analyzing and interpreting the data.
- UVI (Dr. Brandt & Dr. Smith) - Provides field support and boat time necessary to complete the field work.

Communications, media exposure, capacity building, education and outreach activities

None

Submissions to CoRIS

None

FY2015 Publications

*Adam, T. C., Kelley M., Ruttenberg B. I., Burkepile, D. E. (2015a) Resource partitioning along multiple niche axes drives functional diversity in parrotfishes on Caribbean coral reefs. *Oecologia* 179:1173-1185.

*Adam, T. C., Burkepile D. E., Ruttenberg B. I., Paddack M. J. (2015b) Herbivory and the resilience of Caribbean coral reefs: knowledge gaps and implications for management. *Marine Ecology Progress Series* 520:1-20.

*Adam, T. C., Burkepile D. E., Ruttenberg B. I., Paddack M. J. (2015c) Managing herbivores for their impacts on Caribbean coral reef ecosystems: A summary report for managers and practitioners PRBD-2015-01. US National Marine Fisheries Service.

*Publications resulting from a closely related CRCP project

FY2015 Presentations

Dubbs AC, Roycroft MR, Ruttenberg BI, Adam TC, Brandt ME. *Significant differences in bite rates and food preferences among parrotfish species*. Presented at the 13th Annual Summer Student Research Symposium, University of the Virgin Islands, St. Thomas, U.S. Virgin Islands, July 31, 2015.

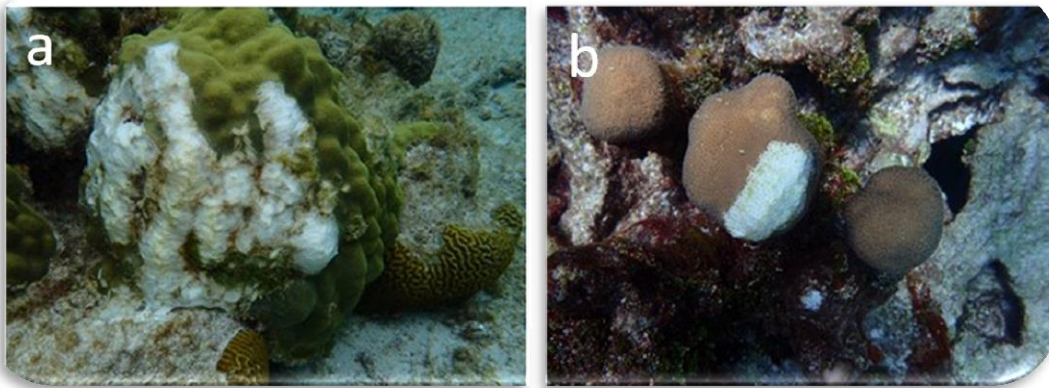
Roycroft MR, Ruttenberg BI, Adam TC, Dubbs AC, Smith TB, Brandt ME. *Quantifying herbivory on coral reefs to develop a metric for management and conservation of Caribbean parrotfishes* Presented at the 96th Annual Meeting of the Western Society of Naturalists, Sacramento, CA, November 6, 2015.

Setbacks or challenges encountered in FY2015

No significant setbacks encountered

Comments on future direction of project

The team is currently using the results from the fieldwork to develop grazing metrics. Work in FY2016 will focus on applying these grazing metrics to survey data from St. Croix to characterize spatial and temporal pattern of parrotfish grazing and the relationship to current and historical management actions.



Predation scars from parrotfish at BIRNM, St. Croix (a) *Porites astreoides* and (b) *Orbicella annularis*.
Photo credit: Tom Adam (UCSB)

Project ID#:	878-2015
Title:	Defining Spawning Dynamics to Manage and Conserve Reef Fish Populations
PIs and co-PIs:	Ron Hill (SEFSC); CoPI: Dr. Rich Appeldoorn (UPR-M), CoPI: Dr. Michelle Schärer(UPR-M)
Duration of Project:	Year 2 of 3 (funding committed for Years 1 and 2)
Project Category:	Reduce Adverse Impacts of Fishing

Brief description of activities conducted in FY2015

Many populations of large reef predators, such as large groupers, are depleted on the insular shelves of the US Caribbean and unable to perform their critical roles in supporting ecosystem health. These groupers gather annually to spawn, are highly susceptible to overfishing, and need the protection of well-designed spatial and temporal management. This project uses hydrophone receivers to record the sounds groupers make during courtship and spawning, documenting the locations and timing of aggregations. In December 2014, digital spectrogram (DSG) long-term acoustic recorders were deployed at sites off western PR prior to the spawning season. The DSGs recorded for six months or more. Throughout the spawning season, divers, using video and laser calipers, repeatedly surveyed the sites to record the size structure, location, and density of groupers, including red hind, Nassau, yellowfin, tiger, and black grouper. The DSGs were retrieved and the data downloaded, post-processed, verified, and archived. Numbers of species-specific grouper calls have been analyzed for red hind to quantify the number of calls per species for the entire season. The times and locations of calls help to define the precise spawning locations and the temporal pattern of the aggregation.

Description of accomplishments & results

During FY15, DSGs were deployed and collected for their recorded grouper courtship and spawning sounds at Abrir la Sierra, Bajo de Sico, Mona Island, and El Seco, near Vieques. More than 256 gigabytes of sound data, collected from 2013-14 from Abrir La Sierra, Mona Island, Bajo de Sico and Tourmaline, were analyzed. Data analysis and post-processing includes standardizing and quantifying recorded sounds to detect the temporal patterns of aggregations. Current analysis is focused on red hind (*Epinephelus guttatus*); although five different grouper species have been verified by their unique calls, and their presence for spawning will be quantified in subsequent analyses. Recordings of these species-specific calls serve as indicators of when and where different grouper species are using aggregation sites, even without diver confirmations. This provides continuous monitoring of spawning activity throughout the winter spawning season.

To supplement and ground-truth the sonic data, divers conducted periodic surveys at DSG-monitored sites (Mona Island, Bajo de Sico, and Abrir la Sierra) and recorded grouper species, locations, size structure, and density. These data provide a better understanding of the distribution of different species of spawning groupers, as well as a standard against which to compare the DSG sound files. Some of the dives were conducted with closed circuit rebreathers by project partners at UPR-M because of depths at which the groupers aggregate (100 - 170 ft.).

In the Northeast (NE) Reserves of PR, available data were compiled into a GIS project. Fishers familiar with grouper spawning sites have provided some sites to explore. Additional information continues to be gathered from area fishers and divers.

Results from this project were presented to the CFMC's Science and Statistics Committee by the project's research partners in FY14 and were the basis for discussions of best management measures to

protect these spawning aggregations. Four oral and poster presentations were made by research partners at the Gulf and Caribbean Fisheries Institute (GCFI) meeting in November 2015 in Panama.

How project supports goals & objectives of CRCP

Reef fish spawning aggregation sites need additional management and conservation as evidenced by localized depletion of large predators, such as groupers. Two of the largest of the Atlantic groupers, Nassau and Goliath, have been depleted throughout their range because of fishing pressure and habitat loss. Puerto Rico has worked to provide some spatial and temporal protection but, to date, little suggests that these species are recovering. This project is characterizing spawning sites of aggregating groupers and other species within designated MPAs, transferring technology from priority areas on the west coast of PR to priority areas undergoing management planning in the NE Reserves of PR.

This project directly addresses Fishing Impact Goal 1 to increase the abundance and average size of key coral reef species. Objective F1.3 calls for efforts to obtain essential life history and ecological information on key species or functional groups to support management actions, and Objective F1.6 calls for conducting applied biological research and monitoring to evaluate effectiveness of spatial and seasonal coral reef ecosystem management actions on key species or groups. This project also supports FI Goal 2 which calls for effective implementation and management of marine protected areas (MPAs). The project is aligned with three objectives under this goal: F2.1, F2.4, and F2.5 which call for identifying priority areas for protection, improving the management of MPAs, and assessing the performance of existing MPAs, respectively. Research applying these complementary, innovative, techniques will provide data needed to fill gaps (improve management) in MPA assessments for Cabo Rojo and NE Reserves, including the newly designated Caribbean Habitat Focus Area, i.e., The NE Marine Corridor and Culebra Island Habitat Focus Area.

How project supports management of coral reef resources

The fisheries of the US Caribbean are considered data-poor by stock assessment scientists and fisheries managers, including the CFMC and PR Department of Natural and Environmental Resources (DNER). Fishery dependent data, largely based on fisheries landings, is inadequate for proper understanding of the population status of most reef fish and fisheries, and many Caribbean stocks have not been the focus of necessary fishery-independent studies. Spawning aggregation studies like this one contribute data and analytical results on the status of spawning stocks (populations) that will improve management effectiveness. Results from supporting studies have already factored into changes in seasonal (closed season for sales of groupers) and spatial fishery regulations (MPA boundary changes) within PR waters and development of similar or compatible regulations in federal waters. Extended findings from this project will refine spatial and temporal understanding of spawning areas on the west coast and is bringing these technological innovations to the MPAs off NE PR. These contributions will help meet management needs for PR DNER and the CFMC and those mandated under the Magnuson-Stevens Act. This work will enhance information on Nassau grouper, which has been proposed for listing under the ESA. All information will support the on-going CRCP work to generate management plans for the NE Reserves and surrounding areas.

List of project partners and their roles

- UPR-M/Caribbean Coral Reef Institute (CCRI) - Conducting research into the locations and viability of reef fish spawning aggregations using active and passive acoustics, diver searches and video, and fisher interviews.
- HJR Reefscaping - PI for a complementary project; Sharing boat access and manpower when advantageous

- UVI- Conducting research into the dynamics of red hind, yellowfin and Nassau grouper spawning aggregations in the USVI. Many techniques and approaches have been shared between the two projects. Collaborative research proposals have been submitted to expand the cooperation between UPR-M and UVI partners.
- UPR, USVI DPNR & PR DNER – Southeast Area Monitoring and Assessment Program in the US Caribbean (SEAMAP-C) is conducting a pilot study investigating the use of passive acoustic monitoring to augment their monitoring of red hind populations. Their DSGs are being managed by UPR-M and UVI and data are being downloaded and analyzed by UPR-M partners. Future plans include technology transfer to build data analysis capabilities.

Communications, media exposure, capacity building, education and outreach activities

The collaborating researchers have lines of communication with Federal (CFMC, SERO) and jurisdictional (PR DNER Fisheries and 'Reserves' Divs.) managers, as well as with collaborating scientists (e.g., UVI, NMFS SEFSC/Sustainable Fisheries, NOS) and PR Sea Grant. This project will continue to report interim and final results to local and federal managers and stakeholders through mechanisms such as Caribbean Council and Science and Statistical Committee meetings. The proposed techniques have also been embraced by PR and USVI fisheries departments for use in the SEAMAP-C surveys, and this project will be in close communication as departmental scientists are trained in data interpretation. As information from this project becomes available, it will be incorporated into the management plan for the NE Reserves and will provide information on fishery use and spawning sites within the reserve. Collaborators (Schärer and Appeldoorn) are working on joint projects with grouper researchers from UVI, and information will be shared across projects to help shape future directions and data analysis. All information will be presented publicly in regional (e.g., GCFI, Association of Marine Labs of the Caribbean) and national/international (e.g., AFS, ICRS) scientific meetings and research findings will be submitted for publication in scientific journals. Data and reports will be provided to CORIS upon completion.

Submissions to CoRIS

Schärer, Michelle and Ron Hill. Passive Acoustic Monitoring of Fish Spawning Aggregations in Puerto Rico, Progress Report, June 2015.

FY2015 Publications

Schärer, M.T., M.I. Nemeth, T.J. Rowell, and R.S. Appeldoorn. 2014. Sounds associated with the reproductive behavior of the black grouper (*Mycteroperca bonaci*). *Marine Biology* 161: 141-147.

Schärer, M.T., R. Nemeth, E. Tuohy, K. Clouse, M. Nemeth, and R. Appeldoorn. 2014. Nassau grouper *Epinephelus striatus* Fish Spawning Aggregations in the US Caribbean. *Proceedings of the Gulf and Caribbean Fisheries Institute* 66: 408-412.

FY2015 Presentations

Rowell, Timothy J., Richard S. Nemeth, Michelle T. Schärer-Umpierre, and Richard S. Appeldoorn. 2013. Combining Acoustic Technologies to Enhance Future Protections for Spawning Aggregations of Nassau (*Epinephelus striatus*) and Yellowfin Grouper (*Mycteroperca venenosa*). Oral presentation. GCFI, Barbados, November 2014.

Tuohy, Evan, Michelle Schärer-Umpierre, Kimberly Clouse, Michael Nemeth and Richard Appeldoorn. The Use of Multiple Acoustic Technologies to Characterize the Spatial and Temporal Dynamics of Nassau Grouper (*Epinephelus striatus*) at a Spawning Aggregation in Puerto Rico. Oral presentation. GCFI, Bridgetown, Barbados, November 2014.

Setbacks or challenges encountered in FY2015

During the winter spawning season, weather can often hamper field activities, limiting some of the planned diving activities. Through the collaborations with local partners, the project is able to accomplish research activities throughout the spawning season.

Comments on future direction of project

The project was designed to support the development of innovative techniques to assess and monitor grouper spawning aggregations off the west coast of PR, initiate similar efforts off the northeast coast, and to advance management capabilities and knowledge in the newly established NE Reserves. Continued support of these efforts should benefit both the development of local management support, and the sharing of effective techniques, as evidenced by the cooperation with the SEAMAP-C program. Year 3 will continue similar efforts, including accelerated planning for NE work, and the project will initiate assessment and monitoring in the NE Ecological Corridor and around Culebra.

IV. PROTECTED CORALS

Project ID#:	1091-2015
Title:	Evaluation of ESA Listed <i>Acropora</i> spp. Status and Recovery Actions
PIs and co-PIs:	PI: Margaret W. Miller (SEFSC), CoPI: Dana E Williams (UM/RSMAS - CIMAS)
Duration of Project:	Year 2 of 3
Project Category:	Other, Protected Corals

Brief description of activities conducted in FY2015

This project completed triannual surveys of permanent *A. palmata* monitoring plots in Florida Keys, as well as an additional unplanned survey to document the 2015 bleaching event. The team assessed the growth and survivorship of *A. palmata* experimental outplants by completing a size experiment that began in 2014 (3 surveys in FY15), initiating an experiment in May 2015 to better understand how different genets perform in different habitats (ongoing), and conducting four surveys during FY15. The project team resurveyed *Acropora* spp. across 16 sites originally mapped in 2006 in order to compare current distribution to what was observed in 2006. The team also revisited additional upper Florida Keys sites previously mapped in 2013 and 2014 to document short-term changes following the 2014 bleaching event. The impacts of two thermal stress events on *A. palmata* were assessed (Fall 2014 and Fall 2015).

Description of accomplishments & results

In FY15, the team surveyed the 24 existing *A. palmata* study plots in January, May, and September, marking the 12th consecutive year for many of the study sites - the longest running *Acropora* monitoring study at this frequency. A remote site in the upper Florida Keys that is only surveyed annually was also surveyed. *A. palmata* study plots in Curaçao were surveyed in May 2015 for the 10th consecutive year. *A. palmata* populations in the Florida Keys experienced a 2nd thermal stress event in Fall 2015. In order to capture the timing and impacts of this event, additional surveys were conducted. Most sites were severely affected by the bleaching event. Although some colonies survived and recovered their normal color, some sites suffered catastrophic mortality. Cumulative losses for both 2014 and 2015 bleaching events amounted to a loss of 1/3 of the *A. palmata* from the upper Florida Keys.

The second phase of the *A. palmata* outplanting genet experiments (in collaboration with Coral Restoration Foundation (CRF) was conducted in 2015. The second experiment is designed to compare the performance of four different genets of *A. palmata* at two different habitat types (inshore and offshore reefs). A total of 720 fragments from the CRF nursery were outplanted to three inshore reefs and three offshore reefs to compare the survivorship and growth of the four genets. Five surveys were conducted through summer and fall to assess condition of the fragments due to the bleaching event. Bleaching was widespread among the outplanted fragments as it was in the wild population and varied between genet and habitat type. This is the first known, definitive documentation of differential bleaching susceptibility among genets of *A. palmata* (see Fig. below).

Upper Florida Keys sites previously mapped in 2013 and 2014, (n=10) and some previously mapped in 2006 (n=6) for presence/absence were re-visited in summer/fall 2015 to map the locations of all *A. palmata* and *A. cervicornis* colonies using GPS (Project Activity: Resurvey of 2006 *Acropora* spp. mapped

locations). Snorkelers surveyed with GPS to map the presence or absence of *Acropora* spp. Preliminary analyses show long term (2006 to present) losses at many sites as well as losses associated with the 2014 thermal stress event.

How project supports goals & objectives of CRCP

This project addresses the CRCP commitment to support the science and recovery of ESA listed coral species. Specifically, this project provides ongoing population monitoring and also evaluation of proposed recovery actions to conserve/expand *Acropora* spp. tissue. In addition, the project supports multiple CRCP national objectives. For instance, objective F2.1: Five of the seven FL demographic monitoring sites are in no-take reserves. *A. palmata* provides habitat for economically important fisheries species and structural protection for coastal habitats as a 'key taxa' in reef crest environments. Demographic monitoring provides means to assess stability or increases in *A. palmata* abundance in these areas. F2.3: Proposed experiments will restore *Acropora* live tissue and will help refine *A. palmata* outplanting as a management tool to yield additional tissue. C4.1: Developing intervention strategies to preserve coral/increase resilience in priority areas. Any augmentation of live coral, particularly threatened ones, increases population resilience.

How project supports management of coral reef resources

The State of Florida has articulated several priorities that are addressed by the current project. Specifically, FL identified *Acropora* monitoring as one of its top five mapping and monitoring needs to support management as stated in the Coral Reef Ecosystem Integrated Observing System (CREIOS) Workshop Report (Morgan & Waddell (eds) 2009, p.2). Similarly, endangered species recovery and reef restoration both appear as FL management priorities (p.19 Morgan & Waddell 2009) and the outplanting field experiments address these priorities. These FL priorities articulated in the CREIOS report are backed up in the Florida Reef Management Priorities document which calls for implementation of the CREIOS Workshop outcomes.

List of project partners and their roles

- SERO Protected Resources - Co-funding for monitoring of listed coral species.
- Coral Restoration Foundation - Provides and outplants *A. palmata* fragments from their nursery according to the agreed project design.

Communications, media exposure, capacity building, education and outreach activities

This project provided an internship and thesis project for UM/RSMAS Masters student Katryna Kerr.

Submissions to CoRIS

See publications

FY2015 Publications

Williams DE, Miller MW, Bright AJ, Pausch RE (2015) Quick Look Report: 2014 *Acropora palmata* bleaching event in the upper Florida Keys. Protected Resources and Biodiversity Division Report PRBD-2015-02, NOAA SEFSC, Miami, FL, p 22- 'bonus (FY15) product' submitted to CoRIS 9/29/2015

Bright et al. 2015. Enhanced susceptibility to predation in corals of compromised condition. PeerJ 3:e1239 <http://dx.doi.org/10.7717/peerj.1239> Open Access peer-reviewed publication

Pausch RE, Miller MW, Williams DE, Bright AJ (2015) Effects of outplant size on *Acropora palmata* fragment survivorship, growth, and condition. Protected Resources and Biodiversity Division Report PRBD-2015-03, NOAA SEFSC, Miami, FL, p 12

NCEI Archived Data:

- Temperature logger data from FL and *A. palmata* survey data from both FL and Curaçao were submitted to the National Centers for Environmental Information (NCEI): Water temperature data from reef sites off the upper Florida Keys from 2003-09-18 to 2014-12-31 (NCEI Accession 0126994) <http://www.nodc.noaa.gov/cgi-bin/OAS/prd/accession/details/126994>
- Elkhorn coral demographic monitoring from 2004-03-31 to 2015-10-09. Submitted to NCEI, archive pending

FY2015 Presentations

Williams et al, "Impact of the 2014 bleaching event on upper Florida keys (USA) *Acropora palmata*" The 37th Scientific Conference of the Association of Marine Laboratories of the Caribbean (AMLC).

Setbacks or challenges encountered in FY2015

Similar to the Fall 2014 Fla Keys mass bleaching event, Fall 2015 required additional surveys. Due to the significant stress/mortality of the 2014 bleaching event, sites surveyed as part of the mapping component in 2014 were re-surveyed in Summer 2015. These issues reduced the number of sites the team was able to map, but also provided an important opportunity to capture short term changes after a disturbance. The due date of the deliverable associated with this project has been revised accordingly.

Comments on future direction of project

Demographic monitoring will continue, the 2nd phase of the fragment outplant experiment will conclude and a third phase evaluating effects of genotypic diversity and thicket development and growth will begin.

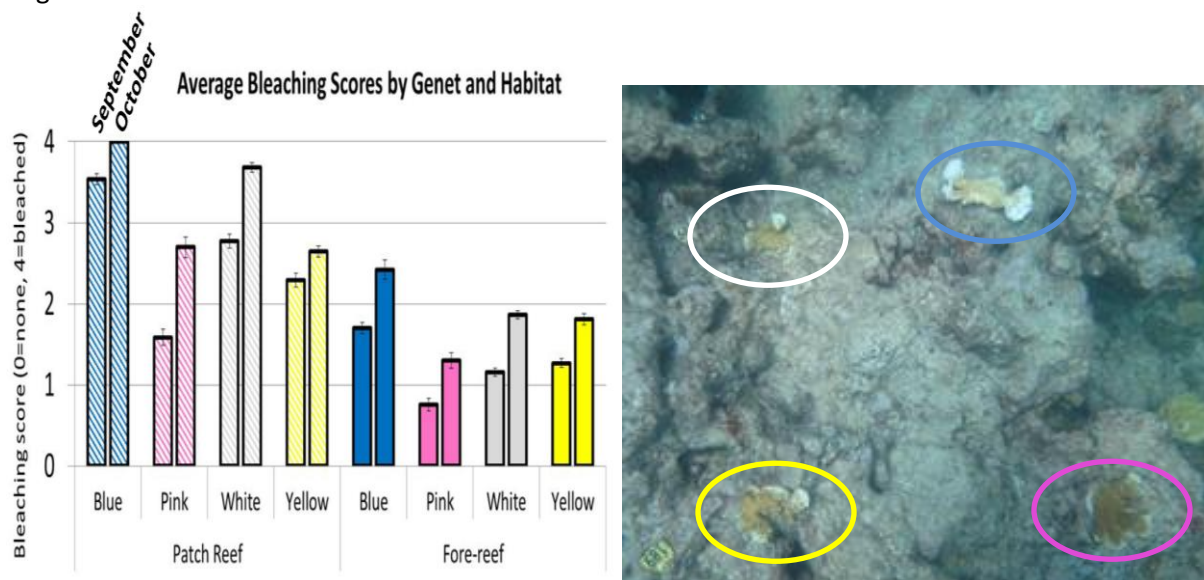


Fig: Mean bleaching score during surveys in Sept. and Oct. 2015 for *A. palmata* outplants of four genets (colors) within two habitat types. Overall bleaching scores were higher in Oct. than Sept., higher in patch reefs than fore-reef habitats, and showed consistent ranking among genets (blue>white>yellow>pink; photo (right) illustrates one replicate of the experimental outplant).

Project ID#:	797-2015
Title:	Gamete/Larval Fitness of ESA Listed and Candidate Corals
PIs and co-PIs:	PI: Margaret W. Miller (SEFSC), CoPI: Cheryl Woodley (NCCOS)
Duration of Project:	Year 3 of 3
Project Category:	Other, Protected Corals

Brief description of activities conducted in FY2015

The researchers conducted experiments examining effects of both parental identity and water quality on fertilization, larval swimming and larval settlement with two ESA-listed species, *Acropora palmata* and *Orbicella faveolata*. Genet-specific spawning performance was documented for these two species.

Description of accomplishments & results

Despite concerns for low spawning performance in 2015 due to severe heat stress in the previous summer, the team was able to collect gametes from both species and perform proposed experiments. There appeared to be a relationship between heat stress and spawning, where individual colonies of *O. faveolata* at Horseshoe Reef which had bleached to a greater degree in 2014, were less likely to spawn in 2015. Results of pairwise fertilization assays conducted in 2015 demonstrated that parental identity strongly influenced fertilization success, consistent with preliminary results in 2014. For *A. palmata*, fertilization assays that were conducted between genets from different sites often showed higher fertilization than from crosses between neighboring genets.

‘Water type’ experiments using two types of chemical filters to remove potential contaminants were conducted in 2015. Although there did not appear to be any beneficial effect of this filtration of Hollywood outfall water, there was some (non-significant) suggestions of benefit in both fertilization and settlement phases of *O. faveolata* of filtration of the local reef water.

This project, in conjunction with many partners, has been developing approaches for enhancing post-settlement survivorship for eventual population enhancement goals. In 2014-2015 experiments were conducted comparing survivorship/productivity in field nursery setting of newly settled recruits with those that had been grown out in laboratory conditions for 1 year (yearlings), as well as 2-yearlings that were fragmented to various sizes and subsequent grow-out degrees. These experiments have demonstrated the benefits of longer periods of lab grow-out and the feasibility of fragmenting very small recruits, accelerating the propagation of new genets from larval culture. Another experiment in 2015 outplanted *A. palmata* 2-yearlings to a reef setting and examined the benefit of temporarily protecting them from grazing by cages. Interestingly, *O. faveolata* settled in 2015 have had unprecedented success in lab culture with over 8000 polyps thriving at the Mote Tropical Research Lab in Feb 2016. The reasons for this strong year class are unknown, but it will be interesting to see if there is strong recruitment to the reef.

How project supports goals & objectives of CRCP

This project supports recovery goals for ESA listed species and lends insight to effects of water quality and land based sources of pollution on coral regeneration, which have been priorities of CRCP.

How project supports management of coral reef resources

Reproductive failure is a primary factor in the decline of reef building corals in the Atlantic region. Factors affecting larval production and larval success for spawning corals are important to understand in order to prioritize management actions that might overcome this failure. This project is testing both genetic and water quality factors that may influence the success of spawned coral larvae for ESA listed and proposed species in the Florida Keys. Better understanding of these factors and their relative contributions to coral spawning and settlement will give managers some indication of the most appropriate interventions to help encourage coral recovery. Additionally, it also contributes to field documentation of coral spawning success in the FKNMS.

List of project partners and their roles

- NOS/NCCOS - Performed molecular assays for gamete/larval condition
- Penn State University - Performed genotyping
- Coral Restoration Foundation – document and collecting coral spawn
- Florida Aquarium– document and collecting coral spawn
- Office of National Marine Sanctuaries/FKNMS – document and collecting coral spawn
- Mote Marine Lab– document and collecting coral spawn and developing approaches to improve post settlement survivorship

Communications, media exposure, capacity building, education and outreach activities

This project contributed coral larvae (*O. faveolata*) to support permitted research projects of graduate students at NOVA Southeastern University (Fogarty lab) and University of Texas/Austin (Matz lab). A Masters student and undergraduate (Hollings) student interns from UM participated in this project.

Submissions to CoRIS

See publications.

FY2014 Publications

Miller MW (2015) Quicklook Report: Coral spawning in the upper Florida Keys, Aug-Sept 2015. http://docs.lib.noaa.gov/noaa_documents/NMFS/SEFSC/PRBD_report/NOAA_SEFSC_PRBD-2015-04.pdf

FY2015 Presentations

Results included in faculty seminars at UM/RSMAS (Feb 2015) and University of North Carolina Chapel Hill (Feb 2015).

Presentation to NOAA CRCP Coral Collaboration meeting (Mar 2015)

Setbacks or challenges encountered in FY2015

None of significance. However, a second summer of severe thermal bleaching in Florida Keys corals during Fall 2015 raises continued concerns that spawning may be poor in 2016.

Comments on future direction of project

A new funded project in FY2016 will be continuing work on these goals, including parental compatibility, spawning success, potential benefits of chemical filtration for fertilization and settlement, habitat quality of different algal turf types for larval settlement, and post-settlement enhancement.



Six-month old *O. faveolata* recruits from 2015 spawn thriving in lab culture. Survivorship and growth of these lab settlers in 2015 has been unprecedented (Credit: C. Page, Mote Tropical Marine Lab).

Project ID#:	30058-2015
Title:	Determination of Competency Period for ESA Broadcasting Corals
PIs and co-PIs:	Margaret Miller (SEFSC)
Duration of Project:	Year 1 of 1
Project Category:	Other, Protected Corals

Brief description of activities conducted in FY2015

During August and September of 2015, researchers collected broadcast-spawned gametes of two ESA-listed coral species in the FKNMS and performed controlled laboratory studies to quantify larval survivorship and settlement competency.

Description of accomplishments & results

For the survivorship curves, replicate aliquots of larvae of both *A. palmata* (100 per replicate) and *O. faveolata* (200 per replicate) were established in standing glass dishes placed in temperature controlled water baths and the number of surviving larvae was counted (see fig. below) at increasing intervals over time until all expired (six weeks for *O. faveolata*). For the competency assays, a separate batch culture of larvae for each species was used. Every other day starting at day two after spawn, replicate aliquots of larvae were placed in small culture dishes with a positive settlement cue (small chip of reef rubble) and the proportion settled after 24 hrs. was scored under a dissecting microscope. Peak settlement response (in the presence of positive cue) was observed at day eight or nine after spawning for *A. palmata*, at which time approximately 75% of fertilized embryos survived. In contrast, *O. faveolata* had a much less entrained competency curve. Settlement response (with positive cue) was well-developed earlier, by day four or five, although only 50-60% of fertilized *O. faveolata* embryos survive to this age. *O. faveolata* settlement response persisted at a similar rate for up to 48 days.

How project supports goals & objectives of CRCP

This project supports recovery goals for ESA-listed coral species by improving life history information, which has also been a priority of CRCP.

How project supports management of coral reef resources

Much of the science supporting management of coral reef MPAs and imperiled metapopulations involves understanding and modelling the connectivity of different reef areas. There is no published information on the duration of larval survivorship and competency for any Caribbean spawning coral species, key determinants of effective connectivity. This project will determine empirical survivorship and settlement competency curves for larvae for between two and five ESA listed species.

List of project Partners and their roles

- Coral Restoration Foundation - Document and collecting coral spawn
- Florida Aquarium - Document and collecting coral spawn
- Office of National Marine Sanctuaries - Document and collecting coral spawn
- Mote Marine Lab - Document and collecting coral spawn
- UM/RSMAS

Communications, media exposure, capacity building, education and outreach activities

Masters and undergraduate (Hollings) student interns from UM participated in this project.

Submissions to CoRIS

None

FY2015 Publications

None

FY2015 Presentations

None, abstract submitted for presentation at ICRS in June 2016

Setbacks or challenges encountered in FY2015

None

Comments on future direction of project

A new funded project in FY2016 will be continuing work on these goals along with other early life history research.



Project staff scoring larval survivorship. This time-consuming exercise was performed every other day in the first week and then at widening intervals over the following two months to document the larval survivorship curve.

V. COUNCIL COOPERATIVE AGREEMENT ACTIVITIES

Project ID#:	SAFMC Cooperative Agreement: NA14NMF4410149
Title:	South Atlantic MPAs and Deepwater Coral Habitat Areas of Particular Concern: Characterization of Benthic Habitat and Fauna
PIs and co-PIs:	PI: Stacy Harter (SEFSC), Andrew David (SEFSC); CoPI: John Reed (Florida Atlantic University/Harbor Branch Oceanographic Institute), CoPI: Stephanie Farrington (Florida Atlantic University/Harbor Branch Oceanographic Institute)
Duration of Project:	Year 2 of 3
Project Category:	Council Cooperative Agreement Activities

Brief description of activities conducted in FY2015

A cruise on NOAA R/V PISCES was conducted June 18-29, 2015. Remotely operated vehicle (ROV) surveys of MPAs and open-to-fishing areas adjacent to MPAs as well as inside the Oculina Habitat Area of Particular Concern were conducted. The survey design targets seven species of deepwater grouper and tilefish, but also includes all fish encountered as well as benthic invertebrates. Multibeam mapping was scheduled to be conducted at night; however the multibeam system was broken so no mapping data were collected.

Description of accomplishments & results

Twenty-two ROV dives were conducted resulting in a total bottom time of 29.5 hours, covering 17.3 km, at depths from 40 to 165 m. A total of 2,132 *in situ* digital images were taken, which included quantitative transect images, general habitat, and species documentation images. Nine shipboard Conductivity-Temperature-Depth casts were made and a temperature/depth sensor recorded each ROV dive.

All fish observed during the ROV dives have been identified to the lowest taxonomic level possible with abundance and density values determined. Habitat analyses were completed through the use of point counts from vertically-oriented still images, habitat characterizations incorporated geomorphology, relief, rugosity, and species abundance and diversity.

How project supports goals & objectives of CRCP

This project directly supports management of mesophotic and deep reefs through information provided to SAFMC on target species and habitat in five MPAs between northern FL and central North Carolina as well as the Oculina Habitat Area of Particular Concern. The information provided from the surveys will help SAFMC assess the performance of the five MPAs, thus contributing to CRCP objective F2.5.

How project supports management of coral reef resources

This project directly supports management decisions. The SAFMC is intimately involved with the selection of mapping targets. Mapping results and data analyses from ROV dives has lead directly to realignment of MPA boundaries and guided the selection of new SMZs (Special Management Zones) for the protection of several deepwater grouper species.

List of project Partners and their roles

- Harbor Branch Oceanographic Institute –lead on benthic invertebrates.
- University of North Carolina at Wilmington, Undersea Vehicles Program– ROV services.

Communications, media exposure, capacity building, education and outreach activities

None

Submissions to CoRIS

None

FY2015 Publications

Harter, Stacey, Reed, J, Farrington, S, David, A. 2016. NOAA CIOERT Cruise Report South Atlantic MPAs and Oculina HAPC: Characterization of Benthic Habitat and Biota NOAA Ship Pisces Cruise 15-02 UNCW Mohawk ROV June 18-29, 2015. Final Report.

FY2015 Presentations

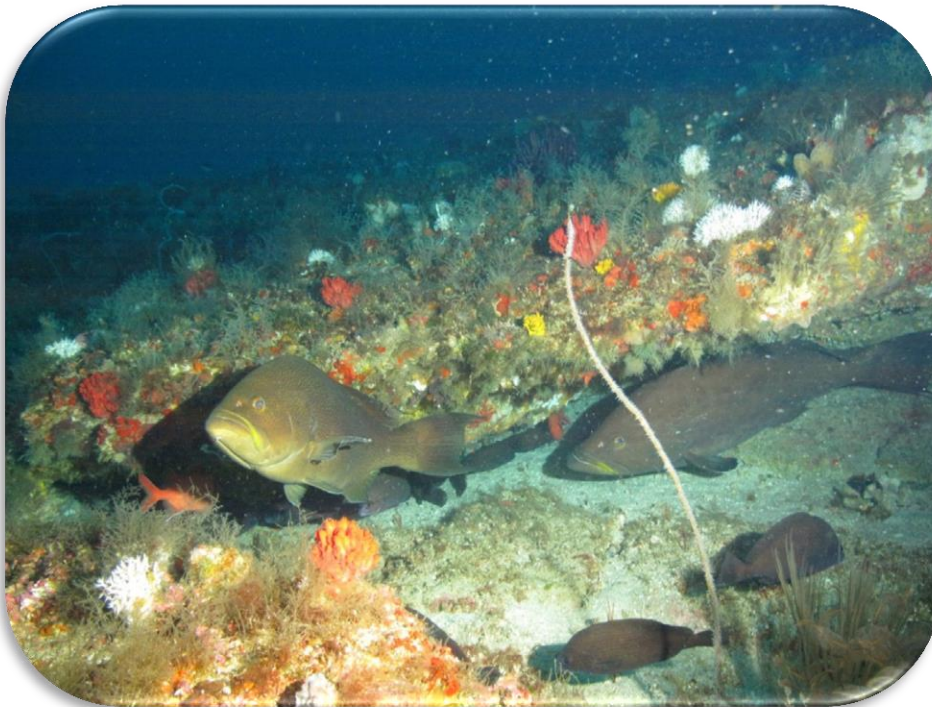
None

Setbacks or challenges encountered in FY2015

A total of four sea days were lost due to A-frame repairs on the NOAA R/V PISCES. A series of equipment and software problems with the PISCES' ME-70 mapping system resulted in no mapping data being collected on the cruise.

Comments on future direction of project

Funding is approved through FY16. Continued surveys are planned, in coordination with SAFMC.



Scamp under a small ledge inside the North Florida MPA.